Large Shafts are not Exclusively Beneficial to Mine Ventilation.

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GENTLEMEN:—My paper is only brief, and an outline on ventilation, although it may be interesting to the hearers, for the reason that it is a subject that is not often dealt with, and sometimes overlooked in practice.

It is common to say, that the up-cast shaft should be larger than the down-cast, which I shall contend to the contrary.

There is only one argument in its favor, which almost every one seems to understand, and that is, the expansion; and although England is supposed to be almost to perfection in mining, as a rule, they make the up-cast the largest on that account, especially where furnace power is used, which must surely be in error, for air only expands a 459 part for each degree of heat imparted to it. So that 459 feet of air at zero, become 469 at 10°, 479 at 20°, 489 and so on, so that in winter, where furnace power is used, it would give the best results, and not make the difference in the velocity for the depth of the shaft only; and as shafts are generally larger than the return air course, the difference of the area would compensate for the expansion caused by the increased temperature, and the velocity in the shaft would only be equal to that in the return air course, which would make no difference to the quantity of air passing in a given time.

Now, I will take the summer, instead of winter, and a fan, instead of a furnace. First, we must understand that the temperature in a mine is about always the same, winter and summer, and whether the mine be ventilated by a force fan to apply pressure at the down-cast, or by an exhaust to take away the pressure from the up-cast, it does away with the expansion in the up-cast; and the increased temperature would be on the surface only, and the only difference would be a bill of expense and a waste of time.

It is only by an increased or decreased pressure that give rise to a ventilation, whether it be by a furnace or fan.

Some people have an idea that a furnace will draw, but that is a mistake; the increased temperature of a furnace will lessen the pressure by making the air lighter, bulk for bulk, so that the pressure of the down-cast would be greater than that of the up-cast, and give rise to a ventilation, and the same natural laws would apply with a fan, whether it would be a force, or an exhaust.

I will now suppose two shafts of equal size and depth, say 60 feet apart with a passage driven from one to the other, if there be no increased pressure at the down-cast, or decrease at the up-cast, there would be no motion in the air, even if one shaft be double the size of the other; the top and bottom being on a level, it would make no difference.

This is contrary to a commonly received notion, but it is, nevertheless, a fact.

It has been ascertained that we have an atmospheric pressure of 14 or 15 pounds to the square inch on the earth's surface, and this is no doubt the reason why people believe that a large shaft would have an advantage of a smaller one on account of its having a greater number of feet and equal pressure on each square foot, but a difference of area would not make any change in this case, or a furnace could only be applied at the smaller shaft.

I will suppose two shafts, one of 60 feet area, and the other 120 feet; if the size of the shaft made a difference, it would be no use to apply a furnace at the large shaft to take away the pressure if the 15 pound per square inch applied on the additional 60 feet of sectional area, for there would be as much pressure applied at the top by the atmosphere as could be taken away by the furnace at the bottom, and there would still be no motion in the air.

Suppose the atmospheric pressure, as a whole, should act as a ventilating pressure, then the large shaft being double the size of the smaller one, there would be 7½ pounds per square inch as a ventilating pressure without any artificial appliance.

Should we apply any artificial means, either fan, furnace, or both, to assist the atmospheric pressure, there is not such a thing as getting 7½ pounds to the square inch as a ventilating pressure.

I have already stated that the ventilating pressure is not derived from the sectional area, but from the depth and additional temperature at the up-cast, so as to make a difference of pressure of the two shafts, which I will endeavor to explain; and to this, it is necessary to give the weight of a cubic foot of air, at different temperatures, and under different pressures.

I will suppose two shafts of 60 feet area, and 600 feet deep, the down-cast to have a temperature of 50° and the up-cast 150°, what would be the ventilating pressure? It has been proved, that 459 cubic feet of air weigh 39.76 nearly, when the barometer registers 30 inches, but if the barometer only register 1 inch, the weight would only be 1.3253×30 inches$=39.759$.

To find the weight of a cubic foot of air, it would require the co-efficient of expansion 459 added to the temperature of the down-cast $50^\circ = 509$; deviding the total product 39.759 by $509 = .0781$, multiplied by the depth of the shaft, 600 feet, $= 46.86$ on each square foot at the bottom of the down-cast, and of up-cast, say $150^\circ + 459$ (co-efficient) $= 609$, divided into $39.759 = .0652 \times 600$ (feet depth) $= 39.12$, the pressure per square foot, at the bottom of the up-cast.

Now the pressure per square foot of up-cast, subtracted from the pressure per square foot of down-cast, $46.86 - 39.12 = 7.74$ lbs. per square foot as a ventilating pressure.

This means 7.74 lbs. pressure, on each square foot of sectional area, for the full depth of the shaft, 600 feet.

This multiplied by the number of feet passing per minute, and divide the result by 33000, would give the horse power of the furnace.

Now, by this formula, we get 7¾ lbs. per square foot, by furnace power; the shafts being equal in size and depth, and if we double the size, without changing the depth and temperature, the pressure would remain the same, but if we change the depth to ½, the temperature remaining the same, we only get ½ the pressure.

Now let us take the 60 feet shaft, and 120 feet in area, and the atmospheric pressure.

I have already stated, that the atmospheric pressure is nearly 15 lbs. to the square inch, and if one shaft be double the size of the other, and the atmosphere should act we must have 7½ lbs. per square inch as a ventilating pressure, irrespective of the depth, even if the shaft was only 10 feet deep.

Now I think there is quite a difference between 7½ lbs. on the square inch, 10 feet deep, and 7¾ lbs. on the square foot, 600 feet deep.

I say, there is nothing in it, but a waste of time, and a bill of expense, and I think I have said sufficient to convince you all, that large shafts are not exclusively beneficial to mine ventilation.

The Institute was next entertained with a paper on the Black Band Ore Fields of Post Boy in Tucarawas County, by Captain Joseph B. Morris of Coshocton, who is engaged in the mining of this celebrated ore. A vote of thanks was tendered Mr. Morris for his very instructive paper.